West Virginia's
Monitoring Strategy

West Virginia Division Of Environmental Protection
Office Of Water Resources
1201 Greenbrier Street
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Office Of Water Resources
Mission

To enhance and preserve the physical, chemical and biological integrity of surface and ground waters, considering nature and health, safety, recreational and economic needs of humanity.

Vision

The Office of Water Resources provides leadership on all water issues through effective programs that improve water quality and public safety statewide.

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Division of Environmental Protection
Director

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Chemical plant along the lower Kanawha River

I. Introduction

Numerous state and federal laws and programs empower West Virginia's regulatory agencies to protect the state's water resources. West Virginia agencies having regulatory authority include the Division of Environmental Protection, the Bureau for Public Health, the Department of Agriculture, and the Soil Conservation Agency. The Division of Environmental Protection (DEP) regulates oil, gas, and coal extraction, and monitors and enforces regulations involving solid and hazardous wastes, air quality and water quality. The Office of Water Resources (OWR) and DEP's Office of Environmental Enforcement (OEE) collect most of the state's water quality data. OWR is responsible for general water quality monitoring and watershed assessment. The mission of the OWR is "to enhance and preserve the physical, chemical, and biological integrity of surface and ground waters, considering nature and the health, safety, recreational, and economic needs of humanity." OEE enforces environmental laws and regulations by investigating complaints, resolving violations, and assuring discharge permit compliance. OEE's mission is that "Environmental Enforcement promotes compliance with the Solid Waste Management Act, the Water Pollution Control Act, and the Groundwater Protection Act by providing assistance and/or enforcing conditions required of municipalities, solid waste facilities, manufacturing industry, and the general public in order to advance the lawful management of solid waste and wastewater."

The federal Clean Water Act (CWA), enacted in 1972, contains many statutory provisions to control sources of pollution to support the OWR's mission. The Act authorizes the states to implement programs to regulate point source discharges and stormwater runoff and to manage pollution from agriculture, mineral extraction, logging and construction. Furthermore, West Virginia Code . 22-11 (the Water Pollution Control Act) creates a public policy to maintain reasonable standards and purity for West Virginia waters to support public health, the propagation of wildlife, and the expansion of employment opportunities.

To comply with the requirements of the Clean Water Act, each state must produce two documents at specified intervals. Section 305(b) of the CWA mandates states to compile water quality data collected by state, interstate, and federal agencies into a water quality assessment report. This document, commonly referred to as the 305(b) report, addresses public health and aquatic life concerns and provides updated assessments of West Virginia's streams, lakes, and wetlands. The second document, called the 303(d) list, is an inventory of water quality impaired streams. The streams on this list are prioritized to identify the impaired streams for total maximum daily load (TMDL) development. A TMDL is a plan of action used to clean up polluted waters. A TMDL plan identifies the pollution source and develops a strategy to reduce or eliminate the pollutants of concern.

A. West Virginia's Watershed Management Framework

In 1996, OWR initiated a new approach to address water quality issues by developing a statewide watershed management framework. The objectives of the watershed management scheme is to coordinate the operations of existing water quality programs and activities in West Virginia to achieve shared water resource management goals. On May 29, 1997, eleven agency and program directors from state and federal water quality agencies signed a resolution of mutual

intent to form a partnership for statewide watershed management (Table 1). The goals of the watershed management partners are to: 1) improve public awareness, understanding and involvement; 2) improve program efficiency; 3) improve program effectiveness (and cost-effectiveness); and 4) improve information/data management. To achieve these goals, the state was divided into a set of 32 hydrologic regions, or watersheds (Figure 1), to be managed on a five-year cycle. Each cycle consists of five phases, which allow the stakeholders to coordinate their activities.

Table 1. Signature agencies for the partnership for statewide watershed management

West Virginia Division of Environmental Protection
West Virginia Soil Conservation Agency
West Virginia Division of Forestry
West Virginia Bureau for Public Health
West Virginia Bureau of Commerce
U. S. Environmental Protection Agency
U. S. Geological Survey
U. S. Office of Surface Mining
U. S. Forest Service, Monongahela National Forest
Natural Resources Conservation Service
U. S. Army Corps of Engineers

The five phases of the Watershed Management Framework are as follows:

1. Scoping and screening – compile existing data, and conduct public outreach to identify problems and issues within the watersheds.

2. Strategic monitoring and assessment – develop and implement a monitoring plan and conduct monitoring assessments.

3. Management strategy development – develop and assess integrated management strategies, including TMDLs.

4. Priority watershed management plan – develop and finalize management plans.

5. Implementation – implement point and nonpoint source management strategies.

The 32 watersheds, which are based on eight-digit hydrologic unit codes (HUC), create manageable monitoring and assessment units. These watersheds have been grouped into five units to formulate a sequence for phasing-in the Watershed Management Framework, creating a five-year cycle. These groupings, presented in Figure 2, balance geographic areas and annual workloads. DEP initiated Phases 1 and 2 in 1996 and the first five-year cycle was completed in 2000.

Cheat River

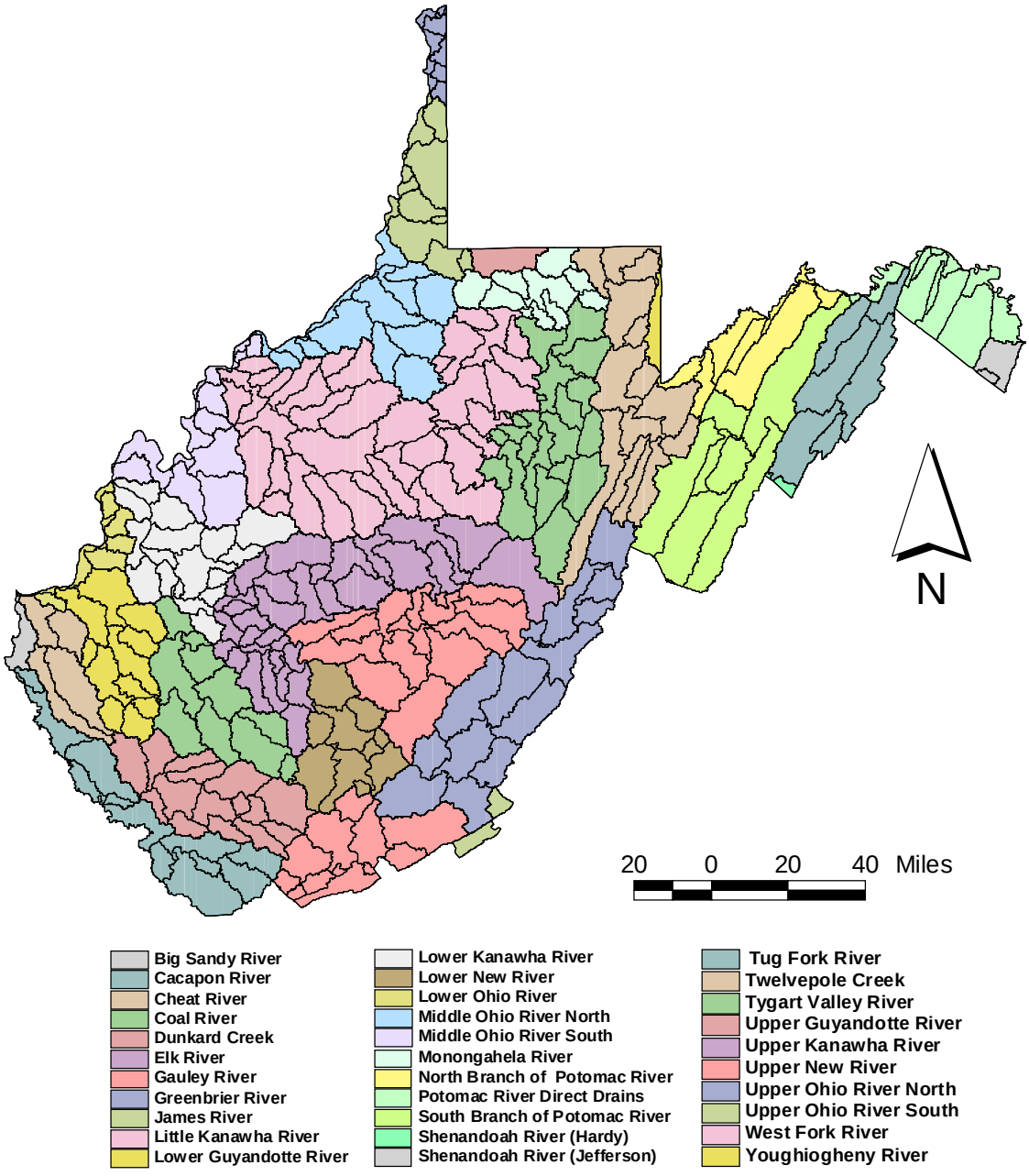


Figure 1. Hydrologic units, or watersheds, in West Virginia

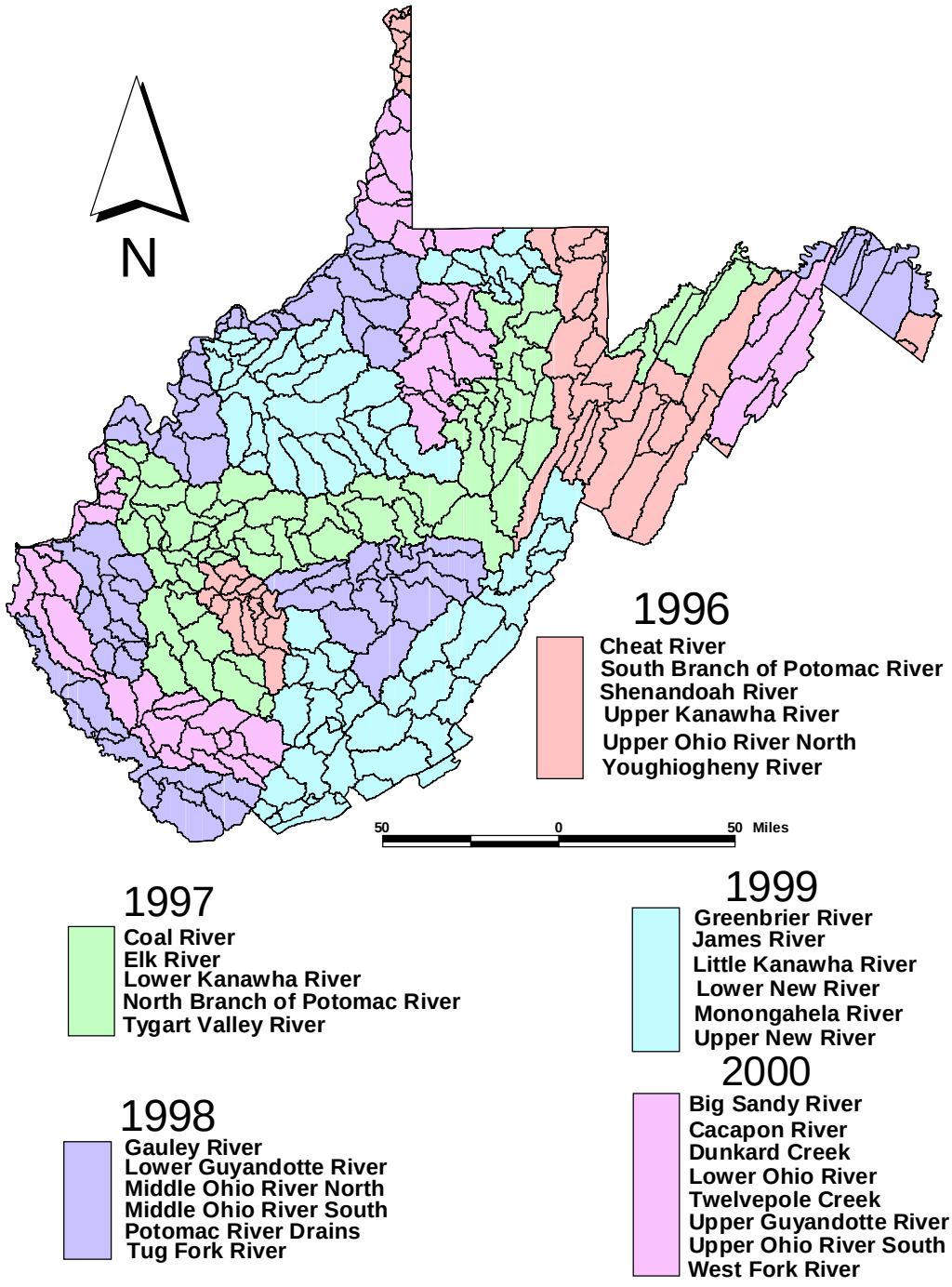


Figure 2. Watershed groupings for assessing watersheds within the five-year cycle

B. Aquatic Resource Definition

DEP monitors and protects the state's streams, lakes and ground water. An atlas of West Virginia's water resources is presented in Table 2. The majority of the state's water resources are found in streams and rivers. Therefore, most of West Virginia's monitoring efforts are focused on these resources.

Table 2. Water resources atlas

State population (1990)	1,793,477
State surface area (square miles)	24,282
Number of watersheds	32
Total number of river and stream miles:	32,278
Number of perennial river and stream miles	21,114
Number of intermittent stream miles	11,164
Number of ditches and canals (miles)	18
Number of border miles	619
Number of publicly owned lakes/reservoirs/ponds	108
Acres of publicly owned lakes/reservoirs/ponds	22,373
Square miles of estuaries/harbors/bays	0
Number of ocean coastal miles	0
Number of Great Lake shore miles	0
Acres of freshwater wetlands	102,000
Acres of tidal wetlands	0

II. Coordination and Collaboration

The primary objective of the Watershed Management Framework is to collaborate with all members of the partnership in the planning, monitoring and assessment of the state's watersheds. The initial step of the planning phase is to conduct public meetings within each watershed to identify areas of concern from Framework Partners and involved citizens. Comments acquired during these outreach meetings are used to select assessment sites. Monitoring activities of the Framework Partners are considered while conducting assessments. Sample sites are selected to support and enhance data collected by local watershed associations and volunteer monitoring groups. Watershed assessments may be scheduled to coincide with monitoring activities conducted by other agencies to prevent repetition and to use resources more efficiently. Finally, all data produced by Framework Partners is validated and incorporated into the overall assessment of the respective watershed.

Sampling for benthic macroinvetebrates

A. Current Monitoring Activities

1. DEP, Office of Water Resources, Watershed Assessment Program (WAP)

Purpose: To collect and interpret water quality and biological information within the state's 32 watersheds on a five year rotation; to provide direction to the water quality control efforts of other agencies; and to measure the effectiveness of these agencies in managing and protecting the water resources of the state. Specific objectives are to provide current, accurate water quality and biological information on the status of the state's surface and ground water; to rank the state's watersheds in order of severity of existing or potential pollution and evaluate the potential for cleanup; and to support stakeholders in the implementation of management and control measures in priority watersheds.

Monitoring sites: It is beyond the scope of this document to list specific sampling sites associated with WAP. Approximately 600 sites are sampled annually, or a total of 3,000 one-time assessments during the five-year cycle. Several protocols are employed in site selection:

1. Probabilistic sites: These assessments are conducted in association with the US Environmental Protection Agency in Corvallis, OR, and were initiated in 1997. A computer randomly chooses a minimum of 30 sites within each watershed. The data attained at these sites can be subjected to statistical analysis to provide an overall characterization of the watershed. This analysis can be used to predict the probability (hence the term "probabilistic sampling") of a condition occurring within the watershed. (Note: watersheds having fewer than 30 streams are not subjected to probabilistic sampling.)

2. Impaired streams: All streams identified in the Waterbody System (a data management tool used in the preparation of the 305(b) report) as "severely impaired" and all streams on the 303(d) list are sampled.

3. Reference sites: These sites are relatively pristine streams and are used to evaluate the quality of all other streams. These sites must meet a number of water quality, biological, habitat, and land use criteria before they can be utilized as references.

4. Collaborative sites: These sites are selected to support research conducted by other state and federal agencies, as well as watershed associations and volunteer monitoring groups. Specific concerns expressed during public outreach meetings are included in this category.

5. Spatial trend sites: Each stream exceeding 15 miles in length is subjected to multiple assessments. The stream is sampled near the mouth and at regular intervals progressing upstream. The number of sites is dependent on the length of the stream: 15-30 miles = two sites; 30-50 miles = three sites; 50-100 miles = four sites; and >100 miles = five sites. Data from these sites provide information on linear trends.

6. Miscellaneous: After all sites in the proceeding categories have been identified, additional sites are selected to attain the objective of 600 sites per year. A percentage of streams in each of the following categories are chosen to fill in data gaps: slightly and moderately impaired streams; unimpaired streams; high quality streams (as identified by WV Division of Natural Resources); and unassessed streams.

Sample Frequency: Sites are sampled one time during the five-year cycle. Reference sites may be subjected to more frequent sampling to provide seasonal data.

Parameters: Each site is sampled for temperature, pH, dissolved oxygen, conductivity, fecal coliform bacteria, and benthic macroinvertebrates. Field crews are instructed to take additional water quality samples when impacts such as mine drainage, nutrient loading or other impacts are suspected. Reference and probabilistic sites are subjected to intensive water quality analyses: Hot acidity, alkalinity, sulfates, chlorides, total suspended solids, total Kjeldahl nitrogen, total phosphates, nitrate-nitrite as nitrogen, magnesium, manganese, aluminum, copper, iron, zinc, and calcium. A detailed habitat assessment is also completed at each location. The habitat evaluation includes the rapid bioassassment protocols (RBP) presented in EPA's "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers". Stream flow measurements may also be obtained at designated sites.

Quality Assurance Procedures: Quality assurance is addressed in detail in the WAP's Quality Assurance Project Plan. This document provides explicit details of the WAP activities and is updated annually. A brief summary of WAP's quality assurance/quality control (QA/QC) efforts follows.

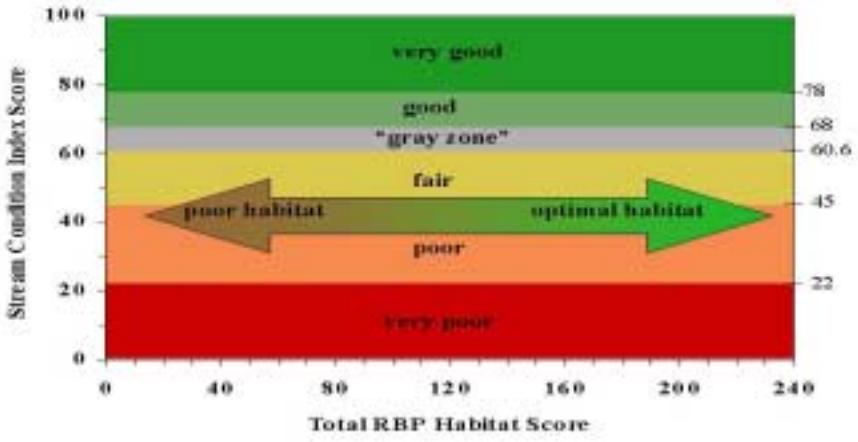
WAP sampling is conducted from April through October. Prior to the field season, all WAP personnel attend a training session that covers all aspects of field work: calibration and use of water quality measuring devices, macroinvertebrate and water quality collection, habitat assessment, stream flow measurement, global positioning systems, and safety. All personnel are given standard operating procedures manuals during training. Hydrolab/YSI units are calibrated weekly prior to field use. Field crews are required to prepare field blanks of water quality samples at specified intervals. Only laboratories certified by DEP's Quality Assurance Officer analyze water samples. These laboratories are required to maintain proper QA/QC documentation. Duplicate sampling is required at 2.5 percent of the sites; supervisory personnel designate these sites. Field crews consist of two team members: The "biomorph" is the person who collects the biological sample and the "geomorph" is the team member who records the habitat data. The biomorph reviews the habitat form for completeness while the team is still on site. Duplicate processing is also performed for the sorting and identification phases of the benthic samples (approximately 10 percent of the samples are reviewed). Supervisory personnel are required to participate in field monitoring activities on a monthly basis to assure that protocols are being followed. Those who did not perform the original data processing review the entire electronic database. Any errors noticed during any of these QA/QC steps are addressed and corrected as they are encountered.

Data Management: All data generated by WAP is entered into a Microsoft Access database. This database is stored on a common drive and will be accessible to OWR employees after the

EQuIS data management program has been implemented. The potential of allowing read-only access via the Internet is under consideration. Much of the WAP information will also be available through STORET.

Data Assessment: Data is evaluated through the preparation of a stream assessment chart (Figure 3). This chart considers the biological and habitat conditions of each stream and compares them to those of the reference sites. The framework for these assessments is the West Virginia Stream Characterization Index (WVSCI). Tetra Tech, Inc., developed this index specifically for use in West Virginia. Stream scores are plotted within this chart and the results are used for overall watershed assessments, 305(b) reporting and 303(d) listing. Streams falling in the green area are considered fully supporting (for 305(b) reporting) or non-impaired (for WAP reporting). The condition of streams in the gray area may be fully supporting or threatened (305(b)). Water quality data must be evaluated to determine if a stream in the gray area is threatened or fully supporting. Often best professional judgment cannot be avoided. The yellow area contains streams that are partially supporting (305(b)) or impaired (WAP). Streams in the orange and red sections are non-supporting (305(b)) or impaired. All streams falling in the yellow, orange and red sections are subject to inclusion on the 303(d) list.

Figure 3: Scoring Categories for WAP Assessed Streams



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2. DEP, Office of Water Resources, Ambient Water Quality Monitoring

Purpose: This program was established in the 1960s to monitor the water quality of many West Virginia streams. The data provide information for trend analyses, general water quality assessments, pollutant loading calculations, et al. This program provides information for WAP on streams that not wadable and, therefore cannot be sampled by conventional WAP methods.

Occasionally, ambient "mini-networks" are established to address localized issues. Mini-network sites are sampled monthly for a period of one to two years.

Monitoring Sites: The ambient network consists of 24 fixed stations (Table 3). These sites were selected to evaluate the state's larger streams near the mouth. Other sites were selected to isolate the impacts from major industrial complexes and other potential sources of impairment.

Table 2: Ambient Water Quality Monitoring Stations

Stream Name	River Mile	Latitude Decimal Degrees	Longitude Decimal Degrees
Tug Fork at Fort Gay	0.2	38.116944	-82.598884
Guyandotte River at Huntington	2.8	38.413889	-82.361111
Guyandotte River at Pecks Mill	73.1	37.926389	-81.981667
Kanawha River at Winfield Locks & Dam	31.1	38.526944	-81.9125
Kanawha River at Chelyan	73.7	38.196944	-81.491944
Kanawha River west of Chelyan	73.5	38.196944	-81.491944
Coal River at Tornado	11.3	38.338889	-81.840833
Elk River at Coonskin Park	4.2	38.385	-81.585556
Gauley River at Beech Glen	6.3	38.226667	-81.154167
New River above Gauley Bridge	1.1	38.150917	-81.179722
New River at Hinton	65	37.651389	-80.886667
New River at Glen Lyn, Va.	95.3	37.373056	-80.860833
Greenbrier River west of Hilldale	5.5	38.64	-80.805278
Greenbrier River at Hinton	1.4	37.650833	-80.858611
Little Kanawha River at Elizabeth	28.6	39.055278	-81.390833
Hughes River west of Freeport	1.5	39.131667	-81.376944
Monongahela River north of Morgantown	97.9	39.658056	-79.993056
Dunkard Creek east of Pentress	1	39.714722	-80.110833
Tygart Valley River at Colfax	6.2	39.435278	-80.133472
West Fork River at Enterprise	12.1	39.423389	-80.276111
Cheat River below Lake Lynn Dam, PA	3.6	39.720833	-79.860278
Cheat River at Albright, W.Va.	29.7	39.495	-79.645
Middle Island Creek at Arvilla	12.2	39.435556	-81071389
Twelvepole Creek south of Ceredo	1	38.555556	-82.516944
Opequon Creek east of Bedington	18	39.516944	-77.889722
Cacapon River south of Great Cacapon	6	39.582056	-78.309194
South Branch of Potomac east of Springfield	13.5	39.446844	78.654444
Shenandoah River at Harpers Ferry	0.8	39.322778	-77.7425

Sample Frequency: All stations are sampled quarterly.

Parameters: The following constituents are determined at each site: temperature, pH, dissolved oxygen, conductivity, total phosphorus, total Kjeldahl nitrogen, ammonia nitrogen, nitrate and nitrite as nitrogen, hot acidity, total alkalinity, hardness, sulfates, chlorides, total suspended solids, iron, manganese, aluminum, lead, zinc, copper, total & dissolved organic carbon, and fecal coliform bacteria.

Quality assurance procedures: All samplers are thoroughly trained and provided with a copy of the standard operating procedures manual. Water quality samples are analyzed at laboratories certified by DEP's Quality Assurance Officer.

Data management: All data associated with this program are entered into the STORET database.

Data assessment: Ambient monitoring data is of primary importance for determining 303(d) listings for the state's major rivers.

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3. DEP, Office of Water Resources, Site-Specific Surveys

Purpose: To assess the impacts of a specific facility or pollution source on a receiving stream. Typically, these surveys are performed to determine if an existing permit is providing adequate protection to the receiving streams or to determine if a facility is causing impairment in the receiving stream. A site-specific survey is essentially a small-scale assessment to examine the impacts of a single source (or set of sources) within a limited area.

Monitoring sites: Monitoring sites are determined as needed. A site-specific survey will include sites below the suspected source of impact, a control site upstream of the sources, and any tributaries that may influence the streams within the study area.

Sample frequency: Unless an ongoing problem is identified, only one survey is performed. The survey may be repeated after corrections have been made at the pollution source to determine the effectiveness of these changes.

Parameters: Parameters will include macroinvertebrate collections and on-site determinations of pH, dissolved oxygen, conductivity and temperature. Other water quality samples are collected as appropriate for the situation. Permit writers are consulted to determine the appropriate parameters.

Quality Assurance Procedures: Quality assurance is the same as described for the Watershed Assessment Program.

Data Management: Historically, all data and final reports were maintained in paper files only. However, WAP has recently created an electronic database for site-specific surveys. Data entry has been completed and the data is currently under review. This information is will be readily available to all DEP employees with the implementation of the EQuIS data management program.

Data Assessment: Data assessment is similar to that used in the Watershed Assessment Program. Results of the study are used to evaluate permit effectiveness and compliance. These studies are also incorporated in the 305(b) report and may support 303(d) listing.

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4. DEP, Office of Water Resources, Intensive/Special Surveys

Purpose: These are intensive studies performed within smaller watershed units. A variety of needs can be addressed through intensive/special surveys. They can be used to develop or revise water quality criteria, to identify and isolate non-point source pollutants, determine the effectiveness of remediation practices and 319 demonstration projects, and/or provide information for TMDL development.

Monitoring sites: Sample locations will vary depending upon the location and objective of the individual survey. Sites are chosen to bracket the impacts of various land uses, assess point and nonpoint sources, and provide information on minimally impacted areas.

Sample frequency: A minimum of three sampling events (during high stream flow, normal flow and low flow conditions) will occur during an intensive/special survey. Sampling during high flows will identify problems associated with run-off, such as increased fecal coliform bacteria and nutrient loading from farmlands and problems associated with sediment. Samples collected during normal flow will indicate typical stream conditions. Low flow sampling will identify problems associated with point sources and seepage.

Parameters: Water quality parameters will vary with the objectives of the specific survey. Macroinvertebrates and habitat data will be collected during the normal flow event. Stream flow will be determined during each sampling event.

Quality assurance procedures: Quality assurance procedures are the same as those reported for the Watershed Assessment Program.

Data management: Results of intensive/special surveys are entered into the Watershed Assessment Program database.

Data assessment: Results of intensive/special surveys are incorporated into WAP reports. These sites will be subjected to the standard WAP assessment. Multiple sampling events will allow for a more intensive assessment of the water quality data than for a typical WAP assessment. These issues will be addressed in the final report.

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5.DEP, West Virginia Division of Natural Resources, and West Virginia Bureau for Public Health, Fish Tissue Contaminant Program

Purpose: To protect consumers of West Virginia fish from ingesting harmful levels of contaminants.

Monitoring sites: Monitoring sites will vary from year to year. Sampling is often opportunistic for this unfunded program. Studies performed by the West Virginia Division of Natural Resources, the Ohio River Valley Sanitation Commission (ORSANCO), the U.S. Geological Survey and other agencies can provide an opportunity to obtain fish for analysis and contaminant data. Streams having the greatest contamination are monitored more frequently.

Sample frequency: ORSANCO provides fish contaminant data for the Ohio River annually. There is no monitoring prescriptive schedule for other locations.

Parameters: Samples consist of single species composites of similar-sized fish. The ideal composite consists of five fish. Only edible portions (fillets) are used. A minimum of one "bottom-feeder" (catfish or carp) composite and one predator composite is obtained at each site.

Fish are analyzed for the following contaminants: Polychlorinated biphenyls (PCBs), chlordane, DDT, dieldrin, heptachlor epoxide, hexachlorobenzene, polyaromatic hydrocarbons, toxaphene, cadmium, chlorpyrifos, diazinon, dicofol, disufoton, endosufan, endrin, ethion, lindane, mercury, mirex, selenium, and turbufos. Dioxin is analyzed only if it is a suspected contaminant or if special funding is provided.

Quality assurance procedures: Fish are not allowed to come in contact with plastic during collection. Specimens are filleted in the field and all sample preparation equipment is thoroughly washed and rinsed between composites. Samples are iced or frozen prior to analysis. Samples are only submitted to West Virginia certified laboratories (except for those of ORSANCO). These facilities are responsible for sample processing and analysis.

Data management: A fish contaminant database is maintained by DEP. Advisory information is available in the state fishing regulations and in the 305(b) report. Advisory information is also available at the following Web site: http://fish.rti.org/.

Data assessment: Contaminant results are compared against a consumption advisory chart (currently under revision) to determine if an advisory is needed. Advisories are risk-based and contaminated fish may fall into one of several categories (one meal/week, one meal/month, six meals/year, or no consumption advised). All three state agencies participate in the decision-making process. The public is notified of advisories through press releases and fishing regulations. Consumption advisories are considered in the preparation of the 305(b) report and 303(d) lists.

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High Falls Of Cheat River On Shavers Fork

6. DEP, Office of Water Resources, Save Our Streams (SOS) Volunteer Citizens Water Quality Monitoring Program

Purpose: To prompt citizen involvement in the improvement and protection of the water quality of the rivers and streams of West Virginia. The focus of this program is to address nonpoint source pollution. This program has two objectives: 1) to provide the state with enhanced ability to monitor and protect its surface waters through increased water quality data collection; and 2) to improve water quality through educational outreach to the state's citizens. Once citizens are actively involved in stream monitoring and restoration activities, they can initiate projects within their own watersheds to improve stream quality.

Monitoring sites: Numerous localized studies are conducted under this program. It is beyond the scope of this document to provide the location of each monitoring site. The program coordinator maintains a database of each monitoring site.

Program participants are not assigned specific monitoring sites by the program coordinator, but they are encouraged to select locations that are crucial to documenting nonpoint source problems. Typically, a new volunteer monitoring group will begin with only a few sites. The volunteers can choose to expand their study area as they become more adept at sample collection.

Sample frequency: Participants are requested to sample their sites four times each year (once per season).

Parameters: Participants in this program conduct biological (benthic macroinvertebrate) monitoring only. Biological monitoring was chosen because:

1) It is a simple, accurate, and easily understood method for determining if a stream is impacted by pollution.

2) EPA has identified biological monitoring as the best method to evaluate the impacts of nonpoint source pollution. Biomonitoring can account for chemical as well as physical degradation.

3) It is a practical and reliable approach for volunteer water quality testing. Biomonitoring equipment is inexpensive and does not rely upon holding times or commercial laboratories to produce accurate results.

4) It allows the average citizen to participate in the actual analysis of a stream's health as opposed to collecting water samples.

Quality assurance procedures: The program coordinator conducts training workshops for volunteers, teachers, and conservation groups. The West Virginia Soil Conservation Agency (SCA) employees serve as regional coordinators. SCA staff members are fully equipped to conduct training sessions, to provide guidance to volunteers performing QA/QC checks and to act as a liaison between volunteers and the program coordinator. Volunteers who are well versed

in the program techniques, have received QA/QC training and are proficient in field techniques and macroinvertebrate identification are allowed to serve as local trainers.

Each volunteer receives extensive initial training in macroinvertebrate identification and will participate in followup workshops. The initial, hands-on workshop is held at a non-impacted stream to expose participants to a diversity of organisms. Another training component is a slide show presenting the identification characteristics of macroinvertebrates and how these organisms can be used to indicate pollution problems. Reference collections are available to test volunteers' identification skills. Volunteers are encouraged to preserve unknown specimens and submit them to regional coordinators for verification.

Quality assurance/quality control workshops are held annually to retrain participants. These workshops provide opportunities to address volunteers' questions and to evaluate, through observation, their monitoring techniques. The coordinator completes a quality assurance checklist, which is used to review sampling procedures and identify sources of error. Volunteers are given an identification quiz; the scores of these quizzes are used to evaluate accuracy at each sampling station.

The program coordinator reviews all field survey sheets submitted by volunteers. If a problem is identified, the coordinator will work closely with the volunteer until the problem is resolved.

Data management: Volunteers mail the results of each sampling event to the program coordinator. After the data is reviewed for accuracy, it is input into a DEP database. Copies of all surveys are maintained in files.

Data assessment: Citizen monitoring programs fill in data gaps that cannot be addressed by DEP due to limited resources. These surveys can identify problem areas that need to be subjected to more intensive sampling by DEP and they can also indicate the improvements in water quality resulting from the implementation of best management practices. Information gathered by these groups is an important component in the preparation of the 305(b) report.

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7. Various Agencies and Organizations, Other Volunteer Stream Monitor Programs

Purpose: There are several other citizen's monitoring programs in addition to OWR's SOS program. These programs serve to encourage concerned citizens and environmental groups to participate in water resources monitoring and protection. Because federal and state resources are limited and intensive studies cannot be provided for every stream, volunteer organizations can help fill in gaps that governmental sources are unable to address. Concerned citizens are provided the funding and training to evaluate water quality and macroinvertebrate life within their local watershed. These groups can be the first to identify problems and notify DEP employees when action needs to be taken.

There are a variety of volunteer monitoring groups, which are supported by diverse funding sources. Within DEP are the Stream Partners Program and the Stream Restoration Group. Canaan Valley Institute, the West Virginia Rivers Coalition, the Ohio River Valley Sanitation Commission and U.S. Environmental Protection Agency are also major supporters of volunteer stream monitoring in West Virginia. Teachers conduct educational programs that incorporate water quality monitoring across the state. There are approximately 45 volunteer groups in West Virginia.

Monitoring sites: Monitoring sites are diverse and constantly changing as groups enter and exit the volunteer program. Representatives of the supporting organizations provide guidance on site selection to assure that the information collected by volunteers will provide data that is useful to the sponsor.

Sample frequency: Sample frequency and parameters will vary dependent upon the objectives of the volunteer group.

Parameters: See above.

Quality assurance procedures: Hands-on training sessions are presented to volunteers prior to the initial sampling event. The sponsoring agency will provide guidance in the selection of sampling locations.

Data management: Results are submitted for review to a designated person within the sponsoring agency.

Data assessment: Volunteers work with the sponsoring agency to address the problems identified by the monitoring group. The results of these assessments may prompt a more intensive study to be conducted by the sponsor. Volunteers are encouraged to participate in the public input phase of the Watershed Management Framework. The Watershed Assessment Program uses comments provided by these individuals for site selection.

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8. DEP, Office of Environmental Enforcement, Compliance Monitoring

Purpose: To perform the inspection and enforcement activities for the Office of Water Resources. Facilities having discharge permits are subjected to inspections to assure they are in compliance with state laws. This activity is accomplished through routine inspections, compliance assistance, compliance evaluation inspections, compliance sampling inspections, and enforcement actions.

Monitoring sites: Ninety-three major facilities and approximately 3,600 minor facilities are monitored.

Sample frequency: Compliance monitoring is performed on approximately 100 facilities each year. Annual inspections are conducted on 10-15 facilities having poor compliance histories. The remaining facilities are inspected as needed, or in response to requests by state or federal regulatory personnel.

Parameters: Water quality parameters will vary dependent on the type of facility being evaluated. Samples will be collected for all parameters covered in the facility's permit. Conductivity, pH, dissolved oxygen, and temperature are obtained at each sample site.

Quality assurance procedures: New employees are subjected to intensive training prior to solo inspections. All water quality samples are submitted to a state-certified laboratory for analysis. Duplicate samples and field blanks are collected once per quarter, with the exception of samples collected for organic chemicals. Duplicates and field blanks are obtained each time organic chemicals are to be tested. Multi-parameter field instruments (Hydrolabs, etc.) are calibrated prior to each inspection.

Analytical problems can be revealed through split sampling. A single sample is collected and divided into two portions: one portion is retained by OEE and analyzed by a DEP-certified laboratory; the second portion is analyzed by the permittee's laboratory.

Data management: Details of compliance monitoring inspections are maintained in an electronic log to facilitate tracking. Paper copies of final reports are submitted to OWR's permits section, EPA Region III and the permittee. Results of water quality sampling are entered into the Permit Compliance System (PCS) electronic database.

Data assessment: The results of a compliance monitoring inspection are compiled into a final report. Violations of water quality criteria, permit limitations, and West Virginia laws are addressed. These reports can trigger site-specific surveys and provide information to be used in developing the 305(b) report and 303(d) list.

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9. DEP, Office of Abandoned Mine Lands & Reclamation, Stream Restoration Group, Holistic Watershed Approach

Purpose: To identify and evaluate mine drainage problems associated with abandoned coal mines. This group compiles literature and historical information on abandoned coal mines and conducts water quality assessments. Results of theses assessments are used to design Abandoned Mine Lands (AML) water treatment projects and to evaluate the effectiveness of these projects after implementation. The Stream Restoration Group also develops acid mine drainage treatment and abatement plans and is developing a database of the abandoned mine lands inventory and the associated receiving streams.

Monitoring sites: A listing of the specific monitoring sites is too extensive for the purposes of this document. Monitoring is comprised of several steps:

1. Study area – A general study area is defined. The mainstem and associated tributaries are defined.

2. Comprehensive monitoring network – This network consists of a set of sampling sites within the study area. The network includes several sites along the length of the mainstem and one site at the mouth of each tributary. This network will be sampled three to six times.

3. Streamlined monitoring network – After comprehensive network sampling has defined mine drainage impaired sites, the list is reduced to form the streamlined monitoring network. The streamlined network allows the group to concentrate its sampling efforts in impacted areas. This network is sampled three to six times.

4. Focus area monitoring network – This is the site-specific phase of the project. The exact source of the mine drainage is examined in detail and all discharges are located and sampled. Additional sites on the receiving streams are identified to assess the impacts of these discharges. These sites will be sampled two or three times. The results of focus area monitoring will be used to develop the technology for treating the mine drainage.

5. Modification of focus area monitoring – The site-specific monitoring is revamped after treatment technology has been evaluated. As the purpose of this phase of the study is to evaluate the effectiveness of treatment technology, sites bracketing areas where treatment is not feasible are dropped from the network. Three to six additional sampling runs will be performed in the modified focus area. The results of these surveys are incorporated into a pre-design water quality study report.

6. Post-construction focus area monitoring network – This network is established after coal mine drainage treatment has been implemented. Sites are chosen to bracket the newly-created treatment sites to determine the effectiveness of these measures. These sites are sampled six times during the first year of implementation. This network is sampled four times during the second year and twice in ensuing years.

The Stream Restoration Group is currently involved in 38 pre-design projects and 19 post-construction projects.

Sample frequency: Sampling frequency is dependent on the phase of the project. Sites are sampled two to six times to span a range of hydrologic and climatologic conditions.

Parameters: Water quality sampling consists of: pH, conductivity, total hot acidity, alkalinity, sulfates, total iron, total aluminum, and total manganese. Field measurements include pH, dissolved oxygen, conductivity, water temperature and stream flow. Macroinvertebrate sampling and habitat assessments are conducted annually at all sites between April and November. Fish population surveys are performed annually at selected locations.

Quality assurance procedures: All field personnel receive intensive training prior to performing field work independently. A step-by-step document describing protocols is available. Field instruments are calibrated according to the manufacturer's direction prior to use. DEP-certified laboratories analyze all water samples. Chain of custody forms are prepared for all samples. Sites are located using corrected GPS readings and are maintained in a database.

Data management: Data associated with these projects are entered into a number of databases: Stream Restoration Group Project Log, Q&A Database, Stream Restoration Group Project Coordinate Log, and the Stream Restoration Group Water Quality Assessment Index.

Data assessment: After each phase, water quality results are tabulated, graphed and compared to identify the most impaired streams. These sites are then incorporated into the more intensive phases of the project. Data from these projects are used to identify streams for 303(d) listing and to correct problems so that the streams may be removed from the 303(d) list. Results of these studies are also incorporated in the 305(b) report and watershed assessment reports.

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10. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Monitoring and Assessment Program (EMAP) and Regional Environmental Monitoring and Assessment Program (R-EMAP)

Purpose: To conduct long-term research, monitoring, and assessments to measure the condition of the nation's ecological resources. EMAP and R-EMAP are similar projects. EMAP is conducted on a national scale, while R-EMAP is restricted to the mid-Atlantic highlands.

EMAP has four major objectives:

1. To estimate current status, trends and changes in ecological indicators with a known level of statistical confidence.

2. To estimate the geographic coverage and extent of ecological resources with a known level of statistical confidence.

3. To seek associations between indicators of natural and man-made stresses and indicators of the condition of ecological resources.

4. To provide annual statistical summaries and periodic assessments of the ecological resources.

R-EMAP goals are as follows:

1. Define reference conditions for the central Appalachian ridge and valley region.

2. Determine whether biological communities differ among the sub-regions in the central Appalachian ridge and valley region.

3. Evaluate the status of stream biota in the mid-Atlantic highlands.

4. Determine if relationships can be established between biological impairment and the possible causes of impairment.

5. Determine if there are trends in water quality in the mid-Atlantic highlands since the National Surface Water Survey in 1986.

6. Determine whether the EMAP approach can be used to restore and manage stream resources on a regional scale.

Both EMAP and R-EMAP examine the condition of plant and animal communities through biological and ecological indicators capable of identifying multiple stressors.

Monitoring sites: To meet the goals of providing statistically sound results, sites for both projects are randomly selected.

Sample frequency: EMAP sites are sampled every four years.

Parameters: Both projects include macroinvertebrate and fish sampling. EMAP also collects periphyton. Water quality sampling includes pH, conductivity, temperature, iron, calcium, total suspended solids, total organic carbon, phosphate, total phosphorus, dissolved oxygen, acid neutralizing capacity, sulfate, magnesium, aluminum species, total dissolved solids, nitrate and nitrite, total nitrogen, and chloride.

Quality assurance procedures: Personnel involved in EMAP and R-EMAP receive stringent training prior to the field season. EMAP has an extensive guidance document explaining the exact methodology, including QA/QC protocols.

Data management: All data for both projects is stored in an electronic database. EMAP data is available on the Internet at the following site: http://www.epa.gov/emap/. Details for EMAP information management are located at:
http://www.epa.gov/emap/html/pubs/docs/imdocs/imsumm.html.
Data and project information for R-EMAP (Region III) may be found at:
http://www.epa.gov/emap/html/remap/.

Data assessment: Data assessment and results are presented at the EMAP R-EMAP Web site. The data is made available at the Web site and this information can be used by other agencies for assessment. Pertinent data produced by these projects are taken into consideration during the preparation of the West Virginia 303(d) and 305(b) documents.

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11. U. S. Environmental Protection Agency, Mountaintop Removal/Valley Fill Coal Mining Survey

Purpose: Mountaintop removal/valley fill (MR/VF) mining involves the removal of overburden to expedite coal extraction. Conventional underground mining can also produce spoil material. The excess spoils have been placed into adjacent valleys, filling in the extreme headwaters of perennial streams, which have intermittent tendencies. The EPA study has three objectives:

1. Characterize and compare conditions in: a) streams that are not mined, b) streams in mined areas with valley fills, and c) streams in mined areas without valley fills.

2. Characterize conditions and describe any cumulative impacts that can be detected in streams downstream of multiple fills.

3. Characterize conditions in sediment control structures (ditches) on MR/VF operations.

Monitoring sites: There are currently 38 monitoring sites for this project. These sites are presented in Table 3. Sampling sites with an asterisk (*) indicate sites where quantitative (Surber) samples are collected.

Sample frequency: Each site will be sampled four times, on a seasonal basis (Spring 1999, Summer 1999, Fall 1999, and Winter 2000). Physical habitat evaluations and substrate size characterizations are performed at each site during one of the sampling events. Temperature will be monitored continuously at the quantitative (Surber) sampling sites.

Parameters: Semi-quantitative (D-net) benthic macroinvertebrate samples, quantitative (Surber net) benthic macroinvertebrate samples, stream flow (velocity), temperature, dissolved oxygen, pH, conductivity, stream physical habitat evaluation, substrate size characterization, and continuous temperature monitoring.

Quality assurance procedures: Quality assurance procedures are detailed the project's program plan. Quality assurance is simplified by having the same individual complete the assigned project component during each sampling event. Duplicate samples are collected at 20 percent of the sites. Field instruments are calibrated according to the manufacturer's direction prior to use.

Data management: Data will be maintained in a Lotus spreadsheet and an Access database.

Data assessment: The final report will compare the benthic macroinvertebrate communities of unmined streams to mined streams with and without valley fills. The data will be used to develop a programmatic environmental impact statement. This information will also be used by DEP to prepare 305(b) reports and 303(d) lists.

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Acid Mine Drainage Flowing From Portal of
T & T Mine on Sovern Run
Cheat River Watershed

Table 4. EPA Mountaintop Removal/Valley Fill Mining Project Station Locations and Descriptions				
Station Number	**Stream Name**	**Watershed**	**Approximate Location**	**Description of Mining Activity Upstream**
MT01	Mud River	Mud River	~ 650 ft downstream of confluence with Rushpatch Br.	Upstream control for Mud River. Minimal inactive mining upstream.
MT02	Rushpatch Br.	Mud River	~ 500 ft upstream of confluence with Mud River.	Unmined
MT03*	Lukey Fk.	Mud River	~ One mile upstream of confluence with Mud River.	Unmined
MT13	Spring Br of Ballard Fk.	Mud River	~ 585 ft upstream of confluence with Ballard Fk.	Unmined
MT14	Ballard Fk.	Mud River	~ 900 ft upstream of confluence with Mud River.	Active mining. Site is downstream of eight valley fills.
MT15*	Stanley Fk.	Mud River	~ 700 ft upstream of confluence with Mud River.	Inactive mining. Site is downstream of six valley fills.
MT18	Sugartree Br	Mud River	~ 2,000 ft upstream of confluence with Mud River.	Inactive Mining. Site is downstream of two valley fills.
MT23	Mud River	Mud River	~ 1,300 ft downstream of confluence with Connelly Br.	Cumulative downstream site for Mud River. Downstream of active mining and 26 valley fills.
MT24	Stanley Fk.	Mud River	Stanley Fk. Drainage, sediment control structure.	Inactive mining. Site is located in a sediment control structure on a fill.
MT25B*	Rockhouse Ck.	Spruce Fk.	~ 1.2 miles upstream of confluence with Spruce Fk. Downstream of pond.	Inactive mining. Site is downstream of one valley fill.
MT32	Beech Ck.	Spruce Fk.	~ 1.9 miles upstream of confluence with Spruce Fk.	Inactive mining. Site is downstream of five valley fills.
MT34B	Left Fk. of Beech Ck.	Spruce Fk.	~900 ft upstream of confluence with Beech Ck. Downstream of pond.	Active Mining. Site is downstream of one valley fill.
MT39*	White Oak Br.	Spruce Fk.	~ 2,000 ft upstream of confluence with Spruce Fk.	Unmined.
MT40	Spruce Fk.	Spruce Fk.	In Blair, directly upstream of confluence with White Trace Br.	Upstream control for Spruce Fk. Downstream of inactive mining and nine valley fills, including two refuse fills.

Table 4. EPA Mountaintop Removal/Valley Fill Mining Project Station Locations and Descriptions				
Station Number	**Stream Name**	**Watershed**	**Approximate Location**	**Description of Mining Activity Upstream**
MT42	Oldhouse Br.	Spruce Fk.	~2,400 ft. upstream of confluence with Spruce Fk.	Unmined.
MT45	Pigeonroost Br.	Spruce Fk.	~ 4,500 ft. upstream of confluence with Spruce Fk.	Inactive mining. No valley fills.
MT48	Spruce Fk.	Spruce Fk.	~ 5,100 ft. downstream of confluence with Beech Ck.	Cumulative downstream site for Spruce Fk. Downstream of active mining and 22 valley fills.
MT50	Cabin Br.	Island Ck.	~ 650 feet upstream of confluence with Jack's Fk.	Unmined.
MT51	Cabin Br.	Island Ck.	~ 1,800 ft. upstream of confluence with Copperas Mine Fk.	Unmined.
MT52	Cow Ck.	Island Ck.	~ Three miles upstream of confluence with Left Fk.	Upstream control for Cow Creek, is influenced by inactive mining.
MT55	Cow Ck.	Island Ck.	~ 1,000 ft. downstream of confluence with Left Fk.	Cumulative downstream site for Cow Ck. Site is downstream of inactive mining and four valley fills.
MT57B	Hall Fk.	Island Ck.	~ 3,600 ft. upstream of Left Fk. Downstream of pond effluent.	Inactive mining. Site is downstream of one valley fill.
MT60	Left Fk.	Island Ck.	~ 5,000 ft. upstream of confluence with Cow Ck.	Inactive mining. Site is downstream of two valley fills.
MT62	Toney Fk.	Clear Fk.	~ 300 ft. downstream of confluence with Buffalo Fk.	Inactive mining. Site is downstream of 10 valley fills.
MT64*	Buffalo Fk.	Clear Fk.	~ 4,900 ft. upstream of confluence with Toney Fk.	Inactive mining. No fills. This site is a candidate for unmined site for Surber sampling, but field visit indicated elevated conductivity.
MT75	Toney Fk.	Clear Fk.	~ 700 ft. downstream of Reeds Br.	Inactive mining. Site is downstream of five valley fills.
MT79	Davis Fk.	Clear Fk.	~ 600 ft. upstream of confluence with Sycamore Ck.	Unmined?

Table 4. EPA Mountaintop Removal/Valley Fill Mining Project Station Locations and Descriptions				
Station Number	**Stream Name**	**Watershed**	**Approximate Location**	**Description of Mining Activity Upstream**
MT81	Sycamore Ck.	Clear Fk.	~ 500 ft. upstream of confluence with Lem Fk.	Inactive mining. No fills. This site is a candidate unmined site for Surber sampling, but field visit revealed the site is a downstream of a mine drainage treatment plant.
MT86	Rader Fk.	Twentymile Ck.	~ 500 ft. upstream of confluence with Twentymile Ck.	Cumulative downstream site for Rader Fk. Inactive mining. Site is downstream of three valley fills.
MT87	Neff Fk.	Twentymile Ck.	~ 800 ft. upstream of confluence with Rader Fk.	Inactive mining. Site is downstream of three valley fills and a mine drainage treatment plant.
MT91	Rader Fk.	Twentymile Ck.	~ 500 ft. upstream of confluence with Neff Fk.	Upstream control for Tader Fk. Unmined.
MT95	Niel Br.	Twentymile Ck.	~ 500 ft. upstream of confluence with Twentymile Ck.	Unmined.
MT98	Hughes Fk.	Twentymile Ck.	~ 200 ft. upstream of confluence with Jim's Hollow.	Inactive mining. Site is downstream of eight valley fills.
MT103	Hughes Fk.	Twentymile Ck.	~ 2,500 ft. upstream of confluence with Jim's Hollow.	Inactive mining. Site is downstream of six valley fills
MT104	Hughes Fk.	Twentymile Ck.	~ 1.3 miles upstream of confluence with Bells Fk. Downstream of pond on mainstem of Hughes Fk.	Inactive mining. Site is downstream of eight valley fills.

12. U. S. Army Corps of Engineers, Great Lakes and Ohio River Division, Huntington and Pittsburgh Districts, Water Quality Monitoring

Purpose: Although the primary mission of the U.S. Army Corps of Engineers (USACE) is to manage structures to provide navigation and flood control, the agency is also committed to water quality management. USACE impoundments can cause drastic changes to a formerly free-flowing water system. Oxygen depletion, nitrogen supersaturation, thermal stratification, excessive loadings of nutrients and sediments, and uncontrolled algae and aquatic plant growth are some of the water quality problems that can result from impounding streams. The USACE maintains water quality management programs and each USACE district is required to produce and annual report. The main objectives of the water quality management programs are: a) to assure that water quality associated with a USACE project is in compliance with federal regulations, b) to establish and maintain a water quality monitoring and data evaluation program, c) to identify existing and potential water quality problems, and d) to define baseline water quality conditions.

Monitoring sites: The USACE conducts water quality monitoring in association with its flood control structures and navigational locks and dams. Tables 5 and 6 present the monitoring approaches for the Pittsburgh and Huntington Districts, respectively.

Sample frequency: Refer to Tables 5 and 6.

Parameters: Parameters are variable depending on the nature of each USACE structure and the unique situations associated with it. The major problems under investigation are presented in Tables 5 and 6.

Quality assurance procedures: Information on quality assurance is not included in USACE annual reports and, therefore is not readily available for inclusion in this document.

Data management: The Army Corps of Engineers does not have a centralized management system for water quality data. Each district has developed data management systems that satisfy their individual needs.

Data assessment: Data are summarized in an annual report prepared by each district. The primary goal of USACE is to maintain navigation and to provide flood control; most of the data assessment is associated with these issues. Water quality information is used primarily to alert state and federal regulatory agencies of problems and to work with these agencies to resolve them.

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Table 5. USACE Monitoring Sites in West Virginia Pittsburgh District			
Monitoring Site	**River System**	**Water Quality Problems Monitored**	**Sampling Frequency**
Tygart River Lake	Tygart Valley River	AMD, sewage, mineralization of inflow.	Not specified
Stonewall Jackson Lake	West Fork River	AMD, siltation, algal blooms, spring temperature control, oil & gas extraction, heavy metals, oxygen depletion	Not specified
Morgantown Lock & Dam	Monongahela River	AMD, algal blooms, total dissolved solids, domestic waste	Not specified
Hildebrand Lock & Dam	Monongahela River	AMD, algal blooms, total dissolved solids, oxygen depletion	Not specified
Opekiska Lock & Dam	Monongahela River	AMD, algal blooms, total dissolved solids, thermal pollution, elevated hardness, oxygen depletion	Not specified
New Cumberland Lock & Dam	Ohio River	Algal blooms, industrial and thermal pollution, phenolics, domestic wastes, oxygen depletion, combined sewage overflows, zebra mussels	Not specified
Pike Island Lock & Dam	Ohio River	Algal blooms, industrial pollution, phenolics, domestic wastes, oxygen depletion, chemical and oil spills, zebra mussels, combined sewage overflows	Not specified
Hannibal Lock & Dam	Ohio River	Algal blooms, industrial pollution, phenolics, domestic wastes, oxygen depletion, cyanide, chemical and oil spills, zebra mussels, combined sewage overflows	Not specified

Table 6. USACE Monitoring Sites in West Virginia Huntington District

Monitoring Site	River System	Water Quality Problems Monitored	Sampling Frequency
Summersville Lake	Gauley River	Conductivity, pH	weekly
Sutton Lake	Elk River	Sediment, pH	monthly/weekly
Beech Fork Lake	Beech Fork	Overproduction, stratification	monthly/weekly
Burnsville Lake	Little Kanawha River	High oxygen demand, metals, pH, algal blooms, stratification	monthly/weekly
East Lynn Lake	Twelvepole Creek	Metals, sediment, high conductivity from mining, stratification	monthly/weekly
Bluestone Lake	New River, Bluestone River	Algal blooms, manganese, debris	not specified
R. D. Bailey Lake	Guyandotte River	Sedimentation, trash, stratification	monthly/weekly
Winfield Locks & Dam	Kanawha River	Unspecified water quality monitoring	monthly/weekly
Marmet Locks & Dam	Kanawha River	Contaminated sediments.	as needed
London Locks & Dam	Kanawha River	Contaminated sediments	as needed
Belleville Locks & Dam	Ohio River	Unspecified water quality monitoring	monthly

13. U. S. Geological Survey, National Water Quality Assessment

Purpose: The National Water Quality Assessment (NAWQA) Program is designed to assess historical, current, and future water quality conditions in river basins and aquifers nationwide. The primary objectives are to describe the relationships between natural factors, human activities, and water quality conditions, and to define the factors that have the greatest impact on water quality in different parts of the United States. Data provided by NAWQA will be used to assist local, state, and federal agencies and environmental and industrial groups to make informed decisions in the management of water resources. Information from the NAWQA Program is useful for guiding research, monitoring, and regulatory activities in cost-effective ways.

Monitoring sites: Each NAWQA study unit has two general types of monitoring sites:

> Integrator sites – represent water quality conditions in diverse large basins affected by complex combinations of land use, point sources and natural influences. Integrator sites are on major streams that comprise a substantial portion of the study unit. Data from these sites are used to determine the persistence of water quality influences and to assess contaminant transport.
>
> Indicator sites – represent streams in more homogenous situations, usually smaller watersheds with the same land use and geology throughout. Sites are selected to keep stream size, gradient and geomorphic characteristics within a restricted range. Indicator sites on undisturbed drainages are used to establish reference conditions. Indicator sites may also be positioned to evaluate the effects of point source discharges.

NAWQA currently has study units in the Kanawha/New, Allegheny/Monongahela and Potomac basins. The number of sites will vary dependent upon the study unit and the sampling phase.

Sample frequency: The general concept for NAWQA is to conduct intensive sampling on a few selected sites for all parameters (defined below). As data is collected and assessed, more sites are added for more-specialized, less-frequent sampling.

Parameters: NAWQA has three basic sampling components. Each component has unique strengths and weaknesses for assessing water quality. Each component requires its own sampling design.

> 1. Water column studies – assess physical and chemical characteristics. Parameters include: stream flow, dissolved oxygen, pH, alkalinity, conductivity, water temperature, suspended sediment, dissolved solids, major irons and metals, nutrients, organic carbon and pesticides. Trace elements, hydrophobic pesticides, volatile organic contaminants, bacteria and chlorophyll may also be sampled, depending on the objectives of the specific study,

2. Bed sediment and tissue – to collect information on trace elements and hydrophobic organic contaminants. Parameters include: stream flow, dissolved oxygen, pH, alkalinity, conductivity, water temperature, suspended sediment, trace elements, hydrophobic pesticides, polychlorinated biphenyls, and semivolatile organic contaminants.

3. Ecological studies – evaluate the effects of physical and chemical characteristics on aquatic biota. Parameters include: stream flow, dissolved oxygen, pH, alkalinity, conductivity, water temperature, habitat characteristics, and biological communities.

Quality assurance procedures: NAWQA has produced a number of documents describing methods and quality assurance protocols. These documents may be accessed at the following Web site: http://water.usgs.gov/nawqa/protocols/doc_list.html.

Data management: Data associated with NAWQA are maintained in USGS databases.

Data assessment: Types of data assessment will vary depending on specific needs of the study unit. A summary of the Potomac River data collected from 1992 through 1996 provides assessments of nutrient and pesticides in streams and ground water, organic contaminants and metals in streams, radon in ground water, and water quality trends and outlooks. The Allegheny/Monongahela Study Unit (1996 through 1998) focused on contaminants relating to surface and underground mining, pesticides, nutrients from urban/residential/agricultural land uses, and radon contamination of ground water. Preliminary assessments on the Kanawha/New Basin are not currently available. Data generated from these studies can be used to guide the activities of WAP and provide information for the preparation of the 305(b) report and 303(d) list.

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14. Ohio River Valley Water Sanitation Commission, Year Round Bi-Monthly Sampling and Organics Detection System

Purpose: The Ohio River Valley Water Sanitation Commission (ORSANCO) was established to control pollution in the Ohio River Basin. ORSANCO is an interstate commission representing eight states and the federal government. Member states include: Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia. ORSANCO operates programs to improve water quality in the Ohio River and its tributaries, including: setting wastewater discharge standards; performing biological assessments; monitoring for the chemical and physical properties of the waterways; and conducting special surveys and studies.

ORSANCO's year-round sampling program provides information to identify spatial and periodic trends. Bacteria are monitored during warm months to ensure contact recreation safety. The Organics Detection System is used to detect chemical spills and identify violations of water quality criteria.

Monitoring sites: The ORSANCO water quality monitoring network consists of 31 sites. Fifteen of these sites are within West Virginia (See Table 7.)

Table 7. ORSANCO sample sites and type of information collected.

Stream	Location	River Mile	Sample Type
Ohio River	New Cumberland	54.4	Water quality
Ohio River	Weirton	65.1	Organics detection
Ohio River	Pike Island	84.2	Water quality
Ohio River	Wheeling	86.8	Organics detection
Ohio River	Wheeling	92.8	Bacteria
Ohio River	Hannibal	126.4	Water quality
Ohio River	Willow Island	161.8	Water quality
Ohio River	Parkersburg	190.3	Organics detection
Ohio River	Belleville	203.9	Water quality
Kanawha River	St. Albans	38.3	Organics detection
Kanawha River	Winfield	31.1	Water quality
Ohio River	Gallipolis	279.2	Water quality
Ohio River	Huntington	304.4	Organics detection
Ohio River	Huntington	314.8	Bacteria
Big Sandy River	Louisa	20.3	Water quality

Sample frequency: Water quality samples are collected bi-monthly. Bacteria samples are collected during contact recreation season (May through October). Organic detection samples are collected daily.

Parameters:

1. Bi-Monthly water quality – temperature, pH, conductivity, dissolved oxygen, suspended solids, sulfate, total hardness, total phosphorus, ammonia nitrogen, nitrate/nitrite, chlorides, phenolics, cyanide, magnesium, cadmium, copper, iron, lead, manganese, mercury, zinc, arsenic, and aluminum.

2. Bacteria – fecal coliform bacterial, E. coli.

3. Organics detection system – 1,1-dichloroethylene, 1,1,1-trichloroethane, 1,2-dichloroethane, benzene, bromodichloromethane, bromoform, carbon tetrachloride, chlorobenzene, chloroform, dibromochloromethane, ethyl benzene, methylene chloride, tretrachloroethylene, trichloroethylene, toluene, 1,4-dichlorobenzene, 1,3-dichlorobenzene, 1,2-dichlorobenzene, and 1,2-dichloropropane.

Quality assurance procedures: Laboratories performing water quality analyses must maintain proper QA/QC documentation.

Data management: Electronic databases are used for data management.

Data assessment: Data for this program are summarized every six months. Exceedances of water quality criteria are noted in the report. This information is used in the preparation of the 305(b) report and 303(d) list.

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15. ORSANCO, Biological Assessments

Purpose: To determine if ORSANCO's pollution control efforts allow the Ohio River to support and maintain a healthy ecosystem. Biological assessments include fish and macroinvertebrate population studies as well as a fish tissue contaminant program.

Monitoring sites: Monitoring sites for biological assessments will vary from year to year. ORSANCO's Biological Water Quality Subcommittee agrees upon the exact sampling locations annually.

Sample frequency: The Biological Water Quality Subcommittee decides sampling frequency. Depending on the specific objective of a study, sampling may be repeated two to three times a year at each site.

Parameters: Macroinvertebrates are collected through the use of Hester-Dendy Multiplate samplers. Fish for population studies and tissue analyses may be obtained through electrofishing, gill netting, and rotenone application. Fish used for contaminants analyses are of harvestable size; each sample consists of a composite of 3-10 fillets from a single species.

Quality assurance procedures: All ORSANCO field personnel receive extensive training prior to sampling. Macroinvertebrate identification and contaminant analyses are performed at laboratories having the appropriate QA/QC protocols.

Data management: ORSANCO personnel convert data into electronic format for use.

Data assessment: Macroinvertebrate and fish population data are being used to develop river-specific methods of statistical analysis (index of well being, index of biotic integrity, and macroinvertebrate community index) for these organisms. Ultimately, these tools and the associated data will be used to create a set of biocriteria for the Ohio River.

Fish tissue is used to identify contaminants that cannot be detected in the water column. This information is also used to develop fish consumption advisories. Fish tissue contamination is considered during the preparation of West Virginia's 305(b) report and 303(d) list.

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16. West Virginia Department of Agriculture, South Branch and Lost River Watershed, Water Quality Report

Purpose: The West Virginia Department of Agriculture (WVDA) may conduct special water quality studies to evaluate the impacts of specific problems associated with agricultural activities. One such project is being performed on the South Branch and Lost River watersheds. Several streams in these watersheds were placed on the 303(d) list due to excessive fecal coliform bacteria levels. WVDA has developed an extensive sampling strategy to determine if these streams were erroneously placed on the 303(d) list.

Monitoring sites: A list of streams sampled is presented below. The number in parentheses indicates the number of monitoring sites on the stream.

Anderson Run (3)
Lunice Creek (2)
North Fork of Lunice Creek (2)
South Fork of Lunice Creek (2)
Star Run (1)
Cullers Run (1)
Kimsey Run (2)
Lost River (4)
Upper Cove Run (3)
Mill Creek (1)
North Mill Creek (4)
North Fork of South Branch of Potomac River (9)
South Fork of South Branch of Potomac River (14)
South Mill Creek (5)
Big Run (1)
Broad Run (1)
Jordan Run (2)
Samuelson Run (1)
South Branch of Potomac River (12)
Brushy Fork (4)
Little Fork (1)

Sample frequency: Samples were collected daily Monday through Thursday. Sampling was performed from July 1998 through June 1999.

Parameters: Parameters collected include temperature, fecal coliform bacteria, nitrate, total phosphorous, pH, conductivity, alkalinity, turbidity, and ammonia.

Quality assurance procedures: Sample collectors were trained in sterile sampling and preservation techniques and were required to adhere to a six-hour holding time. Ten percent of all samples were duplicated. All analytical laboratories involved in this study are required to run standards, spiked recovery and duplicate spiked samples. Results of the laboratories are compared to assure that all data is valid.

Data management: Information associated with this report is maintained by the WVDA.

Data assessment: For each parameter, ranges and median values are determined. Median values in each stream segment are charted to demonstrate the changes in the respective contaminant as sampling progresses downstream. Data from this study will be considered in the preparation of the 303(d) list and 305(b) report.

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A Common Problem in Many West Virginia Watersheds

17. West Virginia Soil Conservation Agency (SCA), Section 319 Nonpoint Source Program

Purpose: To evaluate the impacts of best management practices (BMP) in the reduction of nonpoint source pollution.

Monitoring sites: SCA has numerous projects to address issues related to nonpoint source pollution, agriculture production, and construction activities. It is beyond the scope of this document to provide details on each of these projects. Descriptions of major projects are provided below:

Potomac Headwaters Water Quality Project – This project tracks the implementation of best management practices in poultry operations and, to a lesser degree, cattle operations. Ninety-nine percent of the poultry farmers have nutrient management plans. Included in this project are mechanisms to provide technical assistance and cost sharing to control runoff from feedlots, animal waste storage sites, and dead poultry disposal.

Biosolids disposal – SCA is striving to coordinate the land application of biosolids. NPDES permitted waste treatment plants are required to have nutrient management plans if they are land-applying biosolids. One important goal of this project is to develop a calibrated method of spreading biosolids so that the amount per acre can be determined.

Grasslands maintenance – Erosion from poorly managed pastures can greatly impact water quality through the introduction of sediments, fertilizers, pesticides, and animal wastes. SCA is developing and implementing management plans for soil erosion, grazing, and nutrients. This project also strives to reduce livestock stream crossings by developing alternative water supplies, fencing streams and restoring riparian buffer zones.

Watershed-based assistance – SCA provides technical assistance and seed grants to assist local watershed organizations. These efforts have resulted in the removal of large amounts of trash, the development of riparian and stream bank management projects, and water quality monitoring.

Construction program – The goal of this program is to control sediment and erosion for construction sites less than three acres. SCA reviews sediment control plans and has prepared a BMP manual for the construction industry. This program also performed a demonstration project for the construction of a subdivision.

Watershed Resource Center – The training center strives to educate the public on how their daily activities affect their environment and how their willingness to change can positively impact their environmental surroundings. Workshops topics included construction, watershed support, oil and gas training, forestry, agriculture, nonpoint source programs and issues, youth conservation education. The training center also serves as a central location for receiving and distributing publications from a variety of agencies, states, and private companies.

Sample frequency: Not applicable.

Parameters: Not applicable.

Quality assurance procedures: In order to secure 319 grant funding, each project is required to have a quality assurance plan. Quality assurance procedures will vary with the objectives of the study.

Data management: Information on data management is unavailable.

Data assessment: Results of various projects are submitted to DEP's Nonpoint Source Coordinator. This information is used in the preparation of the 305(b) report and the 303(d) list. Nonpoint source issues are also used to direct the activities of the WAP.

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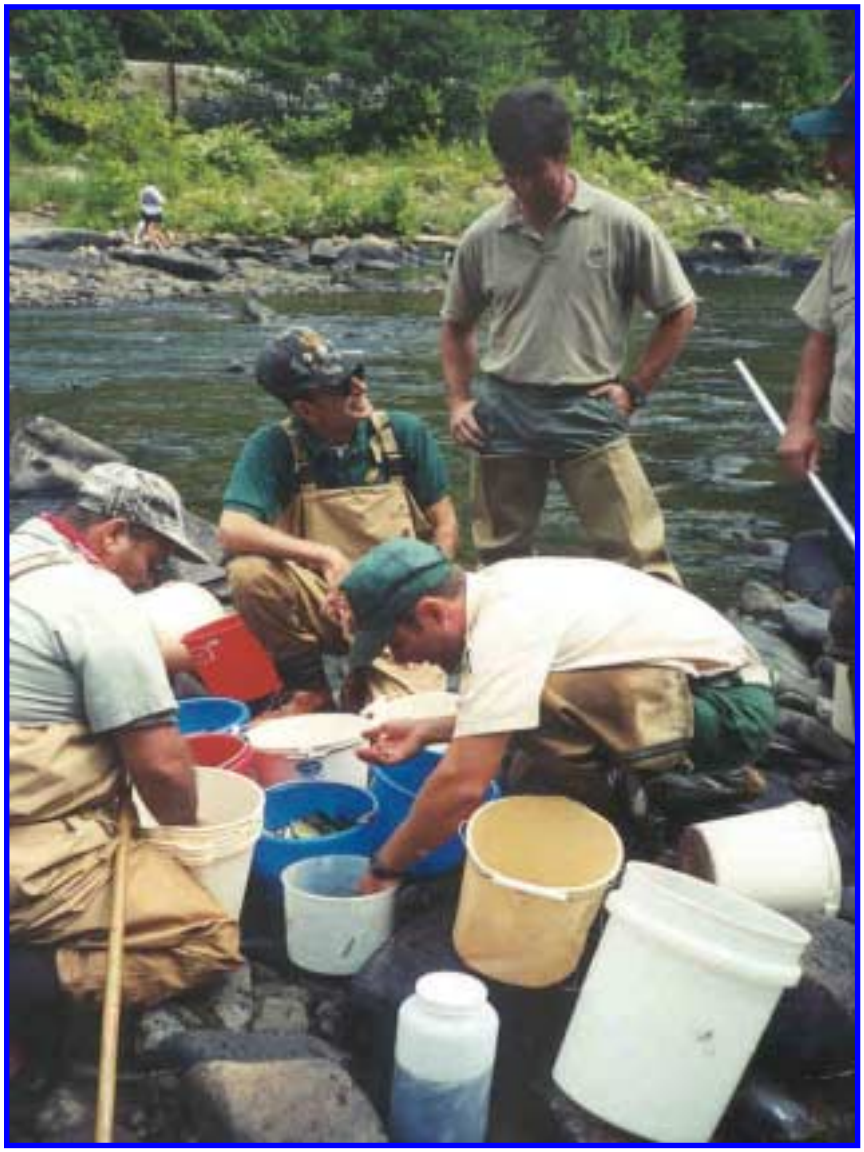
Sediment: Another Common Problem for West Virginia Streams

18. Other/Miscellaneous Programs

The DEP acknowledges the existence of numerous other water quality monitoring programs. Colleges and universities, private organizations, as well as smaller state, federal, and local entities also have projects that involve researching and protecting the state's waters. DEP is aware of and involved in many of these projects. While the information produced by these small-scale studies is considered valuable to the goals and objectives of the DEP, it is beyond the scope of this document to provide details on each of these projects.



Fish survey along the Cheat River

B. Identifying Problems Areas and Data Gaps

The 305(b) report assesses the information produced by all the monitoring activities in West Virginia. The document addresses public health and aquatic life concerns and provides updated assessments of West Virginia's streams, lakes, wetlands, and nonpoint sources. Special state concerns are discussed and existing programs for monitoring and controlling pollution are described. Furthermore, the report provides recommendations for the improvement of water quality management in West Virginia.

Data gaps are identified through the use of the Waterbody database. This database contains a list of all named streams in West Virginia. Each stream that has been monitored by any of the activities listed in the preceding section is assessed for impairment. Causes and sources of problems are identified, the degree of impairment is evaluated and the stream is classified as supporting stream-use categories, non-supporting or threatened. This database can also be used to identify data gaps by identifying unassessed streams. The WAP site-selection protocols are designed to include a percentage of unassessed streams in each watershed.

The Division of Natural Resources maintains a list of high quality streams. The WAP considers these streams when selecting monitoring sites. These sites have the potential to be reference sites and may be subjected to more intensive sampling. If surrounding land use, habitat data, and macroinvertebrate communities suggest these streams are relatively pristine, they are added to the WAP reference site list and are used in data assessment.

III. Design and Implementation

DEP's programs encompass a variety of monitoring designs. Site selection includes both targeted sites (ambient monitoring program, WAP, intensive/special surveys, etc.) and probability-based sites (WAP). Samples can take place during a wide range of hydrologic conditions; in fact, some programs (intensive/special surveys, holistic watershed approach) target periods of high, low and average flows. Water quality is not the only monitoring tool; many of the programs target biological communities and in-stream and riparian habitat. Details of West Virginia's monitoring programs were detailed in the preceding section.

IV. Interpretation and Communication

A. Existing Data

All data collected by DEP and other agencies is evaluated and assessed for inclusion in the 305(b) report in accordance with the 1996 305(b) guidance document. Results of these assessments are stored in the Water Body database. The individual programs conduct data assessments specific to their objectives.

While DEP maintains numerous databases, much of the information resides with the specific workgroup and is not readily available for use by other groups within the agency. DEP is striving to rectify this deficiency through the development of an EQuIS data management system. The EQuIS program, which is in the early stages of development, will store all data produced by DEP and make it accessible and assessable for all employees of the agency. This system will require all workgroups to collect and handle data in a similar manner.

B. Measures Used to Report Progress

The Watershed Management Framework has established methods to report and document progress in water pollution abatement. Now that the initial five-year cycle has been completed, WAP will begin to address the identified issues. Sampling efforts in the second cycle will focus on areas where problems have been documented. Studies will be designed to pinpoint specific sources of impairment, to assess the accomplishments of pollution reduction that have been implemented during the first cycle and to fill in data gaps.

C. Communication

Communicating the results of monitoring studies can be difficult. The target audience must be considered in the preparation of final reports. The WAP has carefully considered all interested parties when developing its reporting criteria. The result is a document that can easily be read and understood at the high school level, but contains the specific details on all data collected for use by the scientific community.

The advent of the Internet has greatly enhanced the ability to communicate monitoring activities to interested individuals. Many agencies have monitoring reports and data available online. DEP is currently enhancing its Internet resources. It is the intent of the agency to make all WAP reports, fish tissue contaminant data, fish consumption advisories, and ambient water quality data available through the World Wide Web.

D. Reporting Objectives

Results of monitoring activities are documented in West Virginia's 305(b) report. This report is currently being produced on a two-year cycle. This report utilized information from the WAP, Ambient Monitoring Network, nonpoint source programs, TMDL development, and assessments produced by other state, national and private entities.

E. Presentation of Data

The style in which data is presented is important to communicate information to the public. WAP reports, which target the general population, are presented in an inviting format. These reports include graphics, photographs, and sidebars within the text of the document. The "drier" scientific data are presented as appendices to satisfy the needs of

researchers and environmentalists. As our skills in desktop publishing improve, an increasing number of DEP reports are being prepared in more appealing formats.

V. Program Evaluation

DEP continuously audits its ongoing programs and assesses their achievements in meeting the specified objectives. Serious departures from the objectives are addressed when they become apparent. Other changes, usually those that will enhance a program (as opposed to altering it), are addressed annually. The WAP updates its Quality Assurance Program Plan and standard operating procedures each year. The 305(b) report also provides an opportunity for evaluating DEP's monitoring programs.

Quality assurance is an important aspect of program evaluation. Specifics on quality assurance/quality control have been addressed for each program in Section III of this report.

VI. Conclusion

To maintain an effective monitoring strategy, all programs involved must continually evolve. The future of each monitoring program must be considered as DEP approaches the final year of the five-year Watershed Management Framework. Adjustments will need to be made to address the problems and issues identified during this initial cycle. Competent planning, coordination and implementation of West Virginia's monitoring programs will allow the state to achieve the goals of the Clean Water Act.

The lack of riparian buffer zones is another common problem for West Virginia streams

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Glossary of Acronyms

303(d) List – a list of water quality impaired streams in West Virginia
305(b) Report – the West Virginia Water Quality Assessment Report
AMD – acid mine drainage
AML – abandoned mine lands
BMP – best management practices
CES – compliance evaluation inspection
CSI – compliance sampling inspection
CWA – the federal Clean Water Act
EMAP – U.S. EPA's Ecological Monitoring Assessment Program
MR/VF – mountaintop removal/valley fill
NAWQA – U.S. Geological Survey's National Water Quality Assessment Program
OEE – Office of Environmental Enforcement
ORSANCO – The Ohio River Valley Water Sanitation Commission
OWR – Office of Water Resources
PCS – Permit Compliance System (a database)
QA/QC – quality assurance
R-EMAP – U.S. EPA's Regional Ecological Assessment Program
TMDL – total maximum daily loads
U.S. ACE – United States Army Corps of Engineers
U.S. EPA – United States Environmental Protection Agency
WAP – Watershed Assessment Program
DEP – Division of Environmental Protection
WVDA – West Virginia Department of Agriculture
SCA – Soil Conservation Agency
WVSCI – West Virginia Stream Condition Index

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